

50X1-HUM

MANUAL OF PONTON BRIDGE BUILDING. VOLUME II

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CHAPTER 5

CONSTRUCTION OF THE BRIDGE SPANS--

A. Assembly of the Abutment Span from the Shore and Disassembly Shoreward.

I. Assembly of the 4.5 Ton Abutment Span from the Shore and Disassembly Shoreward.

121. A construction detachment, whose strength is 1 officer, 3 non-commissioned officers, and 28 men, is arranged as follows:

- leader: 1 officer or non-commissioned officer
- construction squad: 1 non-commissioned officer and 12 men
- 1. carrying squad: 1 non-commissioned officer and 8 men
- 2. carrying squad: " " " " "

For the construction the following equipment is necessary: the equipment included on one abutment span truck, from a ponton truck 1 transverse balk, 2 transverse balk hangers, and 2 large boat-hooks, and from the accessory equipment truck 2 line stakes and a 2-meter rule.

122. For the construction the needed equipment is arranged as indicated in Figure 82, page 108. The circled numbers are herewith listed:

1. Transverse balk.
2. Transverse balk hanger.
3. Trestle shoe.
4. Trestle transom.
5. Trestle column.
6. Equipment chests Nos. 1,2,3,and 4.
7. Tie rod.
8. Abutment sill.
9. Sidebeam (stiffening balk).

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10. Siderail.
11. Curb rail.
12. Deck chess.
13. Longitudinal and transverse lashings.
 - I. Center balk.
 - II. Inner treadway balk.
 - III. Outer treadway balk.
 - IV. Side balk.

The duties of the various squads in assembling the equipage is indicated in the following table:

<u>Squad</u>	<u>Duties</u>
Construction squad	Procure and set up the line stakes in the bridge line as directed by the leader. Procure 2 trestle transoms, 2 trestle shoes, a tie rod, 4 longitudinal lashings, 2 transverse lashings, and equipment chest No. 4. Take from the chest 10 pickets, 2 sledge hammers, 4 transverse lashing pins, and 2 hoists. Fasten the abutment sill and assemble the trestle.
1. Carrying squad	Procure 2 shovels, an iron bar, 2 large boathooks, 5 4-meter balk and 5 2-meter balk, a 4-meter sidebeam and a 2-meter sidebeam, a 4-meter curb rail and a 2-meter curb rail (of different colors), 13 chess, an end chess, and equipment chest No. 3 and 2 of No. 4. Take from the chests 5 balk(connectors) ^{clamps,} a sidebeam clamp, 5 siderail clamps, 4 balk seats (footnote: 5 balk seats in the case of a hinge span), and a sidebeam seat. Fasten the balk and the sidebeam together.

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Squad

Duties

2. **Carrying squad** Procure the same number of balk, sidebeams, curb rails, (of different colors), and chese as the first carrying squad, and in addition a transverse balk, 2 transverse balk hangers, and equipment chests Nos. 1 and 2. Take from the chests the same equipment as the first carrying squad. Fasten the balk and the sidebeam. Place the transverse balk on the ground in front of the trestle transom and attach the lashings to the ends of the transverse balk.

The abutment sill is set up as described in Section 104.

[Section 104 is accordingly included here since Chapter 3 has been omitted].

104. In constructing the shore support, the abutment sill is placed on even ground and levelled visually, and is so placed that it is in the middle of the bridge line and perpendicular to it. The height of the abutment sill above the water level is about 55 centimeters in the case of a "seka" span and 145 centimeters when a hinge span is used. The position for the abutment sill is determined by placing a stake on the bridge line about 4 meters from the abutment sill; a line is fastened to this stake with a "hirttosolmuke" (hitch, see Figure 41 on page 63), and with this line equal distances are measured to the ends of the abutment sill, i.e. an arc is swung with the line (Figure 73, page 88). When the position for the abutment sill has thus been determined, the stakes that are to hold the abutment sill are driven into the ground in the positions indicated in Figure 73. A firm ramp is constructed of earth, stones, twigs, or planks (Figure 74, page 88).

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123. For assembling the trestle, the construction squad arranges itself in double rows alongside the equipment, as is indicated in Figure 83, page 109.

At the command

TRESTLE - ASSEMBLE

the squad arranges itself in such a way that the number-1 men and the number-2 men are at the top ends of the trestle columns, the number-3 men are at the bases of the trestle columns and facing them, the number-4 men at the ends of the trestle transom, the number-5 men are behind the trestle transom, near the number-4 men and facing the trestle transom, and the number-6 men are near the trestle shoes and facing the trestle transom.

The number-4 men open the clamps and with the number-5 men lift the trestle transom while the number-3 men, the number-2 men, and the number-1 men insert the trestle columns into the slots in the trestle transom. About 50 centimeters of the trestle column is placed through the slot. The number-4 men tighten the clamps and insert the transom pins into the first holes below the transom; the number-6 men fasten the trestle shoes.

The number-1 men and the number-2 men attach the upper longitudinal lashing so that the end closer to the chain jack is fastened to the abutment sill and the other end of the lashing is attached to the longitudinal lashing pin inserted in the topmost hole in the trestle column; these men also attach the lower longitudinal lashing in such a way that the end closer to the chain jack is fastened to the abutment sill and the other end of the lashing is attached to the longitudinal lashing pin inserted in the lowest hole in the trestle column. The number-3 men attach the transverse lashings in such a way that the end closer to the chain jack is fastened to a stake or to a tree about

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19 meters from the bridge line, and the other end is attached to a ring fastened to the top of the trestle column. The number-6 men attach the tie rod to the trestle column, so that its pins are inserted in the second holes from the top. The leader directs the positioning of the trestle with the aid of a 2-meter rule. When the trestle is in place, he commands

TRESTLE - RAISE

At this command, the number-3 men, the number-4 men, and number-6 men raise the trestle, by grasping the columns, into an upright position, with the number-5 men using the lower longitudinal lashings to prevent the trestle columns from slipping into the stream. The number-1 men and the number-2 men assist in raising the trestle by supporting the tie rod with a large boathook, near the trestle column. In using a boathook, the practice of inserting it in the holes of the trestle column is prohibited. The number-3 men, the number-4 men, and the number-6 men continue to hold up the trestle while the number-5 men put the seats in place, the extreme seats ^{being put in} in such a way that the pin is inserted through the balk from the inside. The number-1 and the number-2 men handle the longitudinal lashings. The final position of the trestle is not determined until the first length of balk is laid.

124. When the balk and the sidebeams have been fastened in such a way that the balk clamp screws point inward, and the clamp screws of the sidebeam clamps and the siderail clamps point outward, the carrying squads arrange themselves in double file behind the balk, until the squad leader gives the command

PREPARE TO CARRY (TO CARRY - PREPARE)

at which command they proceed to the balk in preparation for carrying the first length of balk.

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As soon as the trestle has been raised, the squad leader of the first carrying squad gives the command

UP - RAISE, MARCH

The squad members carry the balk to the trestle and when the construction squad leader gives the command

BALK - PLACE

place the balk so that one end rests on the abutment sill and the other end rests in the balk seat. If the trestle is not correctly positioned, the construction squad leader directs his squad to move it. When the trestle has been correctly positioned, the balk are set in the balk seats and fastened with pins. The carrying squads leave to procure the second length of balk.

The carrying squad carries the second length of balk to the trestle, and fastens them in place, after which they leave and form a double file behind the chess.

Then when the squad leader gives the command

LONGITUDINAL - AND - TRANSVERSE LASHINGS - SECURE

the number-1 and number-2 men tighten the longitudinal lashings and the number-3 and number-4 men tighten the transverse lashings.

When the squad leader gives the command

CHESS ON SHOULDERS, - PLACE, LAY THE CHESS

the laying of the chess is carried out as described in Section 96.

After this has been carried out, the carrying squads procure the sidebeams and lay them directly in place and follow immediately with the siderails, the curb rails and siderail clamps. The siderail clamps are laid on the deck near the slots in the siderails.

The number-5 men and the number-6 men of the construction squad, as soon as the laying has been completed, fasten the hoists to the trestle columns and raise or lower the trestle transom to the correct height.

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As soon as the siderails have been brought to the deck, the number-1 and number-2 men place the transverse balk.

125. The handling of the trestle transom is the responsibility of the construction squad leader. When both hoists have been attached, the clamps are loosened, the transom pin is removed, and the transom is very carefully lowered or raised, as may be necessary, from both ends simultaneously. In lowering the transom, the chain which supports the transom must be kept taut at all times, i.e. the chain must not be paid out faster than the transom is lowered. When the transom has been positioned at the right height the transom pin is inserted through the transom and the nearest hole on the trestle column, and the transom is allowed to settle to fit the pins, and the clamps are then tightened.

126. When the span is complete, the construction detachment gathers on the span, and at the direction of the leader, rise on their toes and descend upon the deck in unison, to insure that the trestle is firmly in place. The lower longitudinal lashings must be loosened a sufficient amount.

After this loading operation has taken place, in so far as it is necessary, the trestle transom is raised again and the construction squad removes the tie rod. The hoists are allowed to remain in place, with their chains loose.

127. Disassembly is carried out in the reverse order to that of assembly.

When the construction squad leader gives the command

DISASSEMBLE

the squad's number-1 men attach the tie rod and with the help of the number-2 men remove the transverse balk. The number-5 men and the number-6 men lower the transom using the hoist, to rest on the pin

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under it, tighten the clamps, and remove the hoists. The number-3 men and the number-4 men loosen the transverse and longitudinal lashings.

The carrying squads remove the siderails, the curb rails, the sidebeams, and the balk.

In removing the balk, the number-3 men, the number-4 men, and the number-6 men hold up the trestle and detach the balk from their seats, the number-5 men then detaching and carrying away the seats.

When the construction squad leader gives the command

TRESTLE - LOWER

the squad lowers the trestle by having the number-1 men pull on the upper longitudinal lashings, with the number-2 men preventing the trestle from slipping into the stream by pulling toward the shore with the lower longitudinal lashings. The trestle is lowered slowly and the number-3, number-4, and number-5 men receive it by taking hold of the columns. The trestle is pulled to the shore with the lashings and the columns, and it is then disassembled.

II. Assembly of the 7 Ton Abutment Span from the Shore and Disassembly Shoreward.

128. The strength of the construction detachment and the assignment of duties is the same as that for the construction of the 4.5 ton abutment span.

For the construction of the 7 ton span, in addition to the equipment required for the 4.5 ton span, a transverse balk and 2 transverse balk hangers are required from the equipage of a ponton truck.

The positions of the transverse balk are shown in Figure 86, page 115.

Disassembly of the span is carried out in the reverse order to that of assembly.

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III. Assembly of the 12 Ton Abutment Span from the Shore and Disassembly Shoreward.

129. The strength of the construction detachment and the assignment of duties are the same as those for the construction of the 4.5 ton abutment span.

For the construction of the 12 ton span, the following items are required in addition to those required in the construction of a 4.5 ton abutment span:

--2 end chess	Procured from the second abut-
--26 chess	ment span truck or from the pon-
--2 4-meter sidebeams	ton truck and the "seka" span
--2 sidebeam clamps	truck.
--3 transverse balk,	Procured from a ponton truck.
--14 transverse balk hangers	Procured from the accessory
	equipment truck.

The positions of the transverse balk in the span are shown in Figure 87, page 115.

Disassembly of the span is carried out in the reverse order to that of assembly.

B. Construction of the Abutment Span by Erecting the Trestle from the Hinge Span Raft, and Disassembly.

I. Construction of the 4.5 Ton Abutment Span from a Hinge Span Raft.

130. The construction detachment, whose strength is 1 officer, 8 NCO's and 62 men, is arranged as follows:

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--leader: 1 officer
 --hinge span raft squad: 4 NCO's and 28 men
 --abutment section squad: 1 NCO and 6 men
 --construction squad: 1 NCO and 12 men
 --1. carrying squad: 1 NCO and 8 men
 --2. carrying squad: 1 NCO and 8 men

For the construction the equipment required is that contained in 2 ponton trucks, and 1 abutment span truck, and from the accessory equipment truck, line stakes and a 2-meter rule.

131. The duties of the various squads are outlined in the following table:

<u>Squad</u>	<u>Duties</u>
Hinge span raft squad	Procure the equipage for a 4.5 ton floating span, construct the hinge span raft, and receive the trestle assembled by the construction squad.
Abutment section squad	Procure the line stakes, the abutment sill, 2 shovels, an iron bar, and equipment chest No. 4. Set up the line stakes and fasten the abutment sill. Attach the longitudinal and transverse lashings.
Construction squad	Procure the trestle equipage, assemble the trestle, and carry it to the hinge span raft. Procure equipment chest No. 4. Procure from the chests for the shoreward ponton of the hinge span raft: 10 balk seats, 2 side-beam seats and 2 hoists. (Footnote: 2 balk seats are furnished for construction of a hinge span --Figure 119). Obtain and place on the deck, 4 longitudinal and 2 transverse lashings. Transport the raft to the

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	bridge line and set up the trestle; transport the raft away or attach it to the trestle transom to serve as a "seka" span.
1. Carrying squad	Procure 5 4-meter and 5 2-meter balk, a 4-meter sidebeam and a 2-meter sidebeam, a 4-meter and a 2-meter curb rail (of different colors), 13 chess, an end chess, and equipment chests No. 1 and No. 2. Procure from the chests 5 balk clamps, a sidebeam clamp, and 5 siderail clamps. Fasten the balk and the sidebeam together and also serve as carriers.
2. Carrying squad	Procure the same number of balk, sidebeams, curb rails (of different colors), and chess as the first carrying squad and in addition, a transverse balk, 2 transverse balk hangers, 2 mooring cables, and equipment chest No. 3. Take from the chests the same equipment as the first carrying squad. Fasten the balk and the sidebeam together and also serve as carriers.

132. A hinge span raft (Figure 88, page 116) is assembled in the same manner as a 4.5 ton floating span. In construction it differs from the 4.5 ton floating span as follows:

- the balk and sidebeams on the shoreward ponton are not pinned, but are allowed to protrude about 50 centimeters over the outside of the ponton.
- chess is not laid on that part of the balk which protrudes over the shoreward side of the shoreward ponton.
- the anchor is left on shore, unless it is to be cast,
- the transverse balk is placed about 1 meter from the shoreward side of the off-shore ponton,
- the siderails, with their lashings and with the curb rails, are left on the shore,
- the bunk equipage and the guard rails are left on the shore.

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If a "seka" span is to be constructed from the hinge span raft, the hinge span raft squad carries the extra equipment to the vicinity of the abutment span equipage. If a "seka" span is not to be constructed, this squad changes the hinge span raft they have constructed, as soon as it is free, into a floating span.

The construction squad carries the trestle equipage to the area where the trestle span will be assembled.

The trestle is assembled in the same manner as described in Sections 122 and 123, except that

- the trestle columns point toward shore,
- the trunnion of the trestle transom is inserted in the first hole above the transom.

133. When the trestle has been assembled, the construction squad leader gives the command

PREPARE TO CARRY

at which command the squad members arrange themselves as shown in Figure 89, page 119, in preparation for carrying the trestle.

At the command

UP - RAISE, MARCH

the trestle is carried to the hinge span raft where the hinge span raft squad receives it, places it on the deck of the raft and then leaves.

134. The construction squad procures the equipage still lacking, fastens the longitudinal and transverse lashings and transports the span to the bridge line, where the abutment section squad fastens the span to the shore with either a mooring cable or an anchor cable, laid along the bridge line.

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For the handling of the trestle and the hinge span raft, the construction squad arranges itself as follows (Figure 90, page 120):

- the number-1 men handle the lines in the off-shore ponton,
- the number-6 men take positions in the shoreward ponton, where they use large boathooks to help tie in the span; they operate both from the bow and the stern, moving the raft and making it fast.
- the number-2 men and number-3 men station themselves near the trestle columns for raising the trestle into position. The number-3 men take charge of the longitudinal lashings and by holding on to them prevent the trestle from falling toward the shore,
- the number-4 men attach a mooring line to the base of each of the trestle columns, in the lowest free holes, tie the two lines together with a "jalusolmu" (knot, see Figure 47, page 66), run these lines under the trestle transom. Also prevent the trestle from slipping toward the shore on the balk, when the trestle is raised into position.
- the number-5 men station themselves near the trestle transom for lifting the trestle by grasping it.

At the command

RAISE - TRESTLE

the trestle is raised to an upright position and allowed to rest on the ends of the balk. When the trestle is upright, the number-4 men run the lashings over the trestle transom.

At the command

SEATS - PLACE

the number-5 men fasten the sidebeam seats and the balk seats.

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If the next span is to be a hinge span, seats are placed loosely in the space between the side balk and the outer treadway balk (Figure 119, page 158).

At the command

LONGITUDINAL LASHINGS - TO THE SHORE

the longitudinal lashings are passed to the abutment section squad, who fasten them. The construction squad leader commands

BALK - PLACE

at which command the carrying squad brings forth the first length of balk and the number-4 men and number-5 men fasten them in place.

At the command

TRANSVERSE LASHINGS - TO THE SHORE

the number-3 men pass the transverse lashings to the abutment section squad, who fasten them.

At the command

SHOVE OFF

the carrying squad shoves off with the raft, with the men who handle the lines and boathooks keeping the raft in the bridge line, and the rest of the construction squad holding the trestle upright.

At the command

BALK - SECURE

the balk is lowered to the abutment sill and fastened, and at the same time the construction squad leader is directing the maneuvering of the trestle into the bridge line with the commands

RAFT - UPSTREAM (or DOWNSTREAM).

At the command

HOLD, SECURE

the mooring men secure the raft firmly in place with the aid of the men handling the boathooks.

When the trestle is in position, the second length of balk is brought forward and put into place with ^{the} help of a roller-beam.

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At the command

TRESTLE COLUMNS - LOWER

the number-2 men open the clamps and remove the transom trunnion. The number-3 men take positions on the trestle transom, and grasping the trestle columns in their arms, lower them slowly into the water, the number-4 men, meanwhile, assisting by holding on to the lashings. When the trestle columns are in position, the lashings are secured loosely to the trestle transom.

At the command

HOISTS - PLACE

the number-5 men and the number-2 men attach the hoists and prepare to raise the transom as soon as the longitudinal lashings and the transverse lashings have been tightened. At the same time, the construction squad leader commands

LONGITUDINAL AND TRANSVERSE LASHINGS - SECURE

at which command the abutment section squad tightens the transverse lashings and the upper and lower longitudinal lashings, and at the command

TRESTLE TRANSOM - RAISE

the number-2 men and the number-3 men raise the transom to be supported by the hoist, and when the span is ready, raise the transom high enough so that the raft may be detached. After this has been done, chess is laid on the deck, and the sidebeams, with the transverse balk, and the ^{are} siderail equipage/~~xx~~ put in place.

The trestle is tested under load (as described in Section 126) and the transom is set at the desired height and fastened to the trestle columns. The hoists are loosened.

135. Disassembly is carried out shoreward as has been described in Section 127.

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II. Construction of the 7-Ton and the 12-Ton Abutment Span from a Hinge Span Raft.

136. A 7-ton and a 12-ton abutment span (Figures 86 and 87, pages 114 and 115) when constructed from a hinge span raft, are constructed in a manner corresponding to that used for the 4.5-ton span, as has been described in Sections 130-134.

C. Construction of the Trestle Span by Erecting the Trestle from a Hinge Span Raft, and Disassembly.

I. Construction of the 4.5-ton Trestle Span.

137. Whenever the depth of water permits, the off-shore trestle of the trestle span is always erected from a hinge span raft.

The strength of the construction detachment required is the same as that described in Section 130, except that the abutment section squad is omitted. The duties are the same in procuring the equipage and erecting the trestle, with the exception that the trestle span's lower longitudinal lashings are attached to the trestle columns before the first trestle is erected.

From the equipage previously described, the abutment sill equipage is omitted.

The longitudinal lashings on the trestle span (Figure 91, page 123), are so arranged that the chain jacks used in tightening them are near the tops of the trestle columns so that tightening is possible. Tightening of the longitudinal lashings is carried out by the construction squad after the chess has been laid on the deck of the span. The carrying squad tightens the transverse lashings.

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II. Construction of the 7-ton and the 12-ton Trestle Spans.

138. A 7-ton and a 12-ton trestle span (Figures 92 and 93 on page 124) when constructed by erecting the trestles from a hinge span raft, are constructed in a manner corresponding to that used for the 4.5-ton span, as has been described in Section 137.

D. Construction of the Trestle Span by Erecting the Trestle from the Shore.

I. Construction of the 4.5-ton Trestle Span.

139. The trestle span (Figure 91 on page 123) is constructed from the shore when it is not possible to use a hinge span raft.

The strength of the construction detachment is the same as that described in Section 121.

The equipage required in the construction and the duties involved in procuring the equipage is the same as that described in Sections 121 and 122 except that the abutment section equipage is omitted.

When the abutment span's trestles are being raised, the longitudinal lashings of the trestle span are secured to the abutment's lower longitudinal lashing pin, and it is placed on the deck [sic].

140. When the equipment has been organized and the trestle assembled as described in Section 123, the construction squad carries the trestle into position, requesting whatever assistance they need from the carrying squad. If the depth of water makes it impossible to fasten the longitudinal lashings to the longitudinal lashing pins at the bases of the trestle columns, then they are attached before the trestle is carried into position and the carrying squad assists in carrying the lashings.

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The construction squad leader directs the positioning of the trestle in the bridge line and measures the distance from the abutment trestle by having a carrying squad procure the side balk and put them into place. When the trestle is in place, the necessary sidebeam seats and balk seats are put in place, as well as the transverse and longitudinal lashings, and the inner treadway balk are procured and put into place using a roller-beam. Similarly, the second length of balk is procured and the chess is laid.

After the chess has been laid, the transverse and longitudinal lashings are tightened, the sidebeams are procured, and the siderails and transverse balk are put into place.

II. Construction of the 7-ton and 12-ton Trestle Span.

141. Construction of the 7-ton trestle span and the 12-ton trestle span from the shore is carried out in a manner corresponding to that described for the 4.5-ton span, in Sections 139 and 140.

E. Construction of the Floating Span.

I. Construction of the 4.5-ton 8-meter Floating Span.

142. The construction detachment, whose strength is 1 officer, 3 NCO's, and 28 men, is organized as follows:

--leader	1 officer or NCO
--construction squad	1 NCO and 12 men
--1. carrying squad	1 NCO and 8 men
--2. carrying squad	1 NCO and 8 men

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The leader

- determines the construction site and gives the necessary commands for depositing the equipage preparatory to construction,
- directs the construction work, and
- reports on the completion of the span.

143. The equipage from two ponton trucks is required for the construction. The excess equipment is placed beneath the deck of the span and the cases are returned to the trucks.

The equipage is arranged on the shore for construction as is illustrated in Figure 94 on page 126. The duties of the various squads are indicated in the following table:

<u>Squad</u>	<u>Duties</u>
All squads	Put two pontons in the water.
Construction squad	Secure the pontons to the shore and procure two pumps and two equipment chests, both No. 9. Furnish each of the pontons with 6 oars, 6 oarlocks, a large boathook, a small boathook, 2 mooring lines, 2 connecting cables, an antifriction roller, 4 sidebeams hangers, 16 balk hangers and a pump; in a swift current also a capstan with its support arm and support bracket. In addition to the above equipment, a roller-beam is placed in the shoreward ponton and a transverse balk and 2 transverse balk hangers are placed in the off-shore ponton.

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<u>Squad</u>	<u>Duties</u>
1. Carrying squad	Procure 10 4-meter balk, 2 4-meter sidebeams, 2 4-meter curb rails (of different color), 18 chess, an end chess, a bunk beam, an anchor, a reel case with its cable, a marker buoy with its cable, 2 guard rail posts, a guard rail, a line stake, an engineer's sledge, and equipment chests No. 10 and No. 11. Procure from the equipment chests, 5 balk clamps, a sidebeam clamp, 6 siderail clamps, 2 bunk clamps, and 2 movement limiters with their washers. Fasten the balk and the sidebeam.
2. Carrying squad	Same as those of the first carrying squad except that they do not procure an anchor.

The hangers are hung from the ponton rail in such a way that the hanger hook points toward the side of the ponton.

A transverse balk is hung on the shoreward side, outside, of the off-shore ponton and tied at both ends with lines to the gunwale rail in such a way that the balk hangs about a hand's width below the gunwale (See Figure 95 on page 128). In shallow water, the pontons must be far enough from shore that they do not touch bottom, under load. The draft of the pontons under an unloaded span is about 50 centimeters.

When the pontons have been equipped, the construction squad members position themselves in the pontons in such a way that in each ponton there are two men ready to handle the mooring lines and four men as construction men to receive the balk, with two of these men facing the stern and two facing the bow for the first balk delivered. The position of the squad leader is in the bow.

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Each carrying squad, at the direction of the leader, fastens the balk and sidebeams that they have procured and operates as two half-squads such that one half begins fastening the balk from the center balk and works balk by balk toward the siderail, whereas the other half-squad begins from the other siderail and works toward the center balk.

Clamps are then attached and in such a way that the turnscrows on the balk clamps point toward the inside and those on the sidebeam and siderail clamps point toward the outside of the bridge. When this has been done, the squads form a double file behind the balk.

At a signal from the leader of the construction detachment, the leader of No. carrying squad takes charge of both carrying squads and gives the command

PREPARE TO CARRY.

At this command, the squads march to the balk and assume positions in preparation for lifting the inner treadway balk and the side balk, as indicated in Figure 96 on page 130.

Then the squad leader commands

UP - RAISE, MARCH.

When the shoreline is reached, the construction squad leader commands

BALK - FORWARD,

at which the carrying squads' number-1 men hand the balk to^{the} construction squad in the shoreward ponton and help them pass the balk to^{the} construction squad in the off-shore ponton by passing it along hand over hand. The carrying squads' number-1 and number-2 men leave. The construction squad in the off-shore ponton pin the balk to the off-shore gunwale and then bear down hard on the ends of the balk with the weight of their upper bodies. The mooring-line men in the off-shore ponton take the mooring

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cable from the bollard and untie the "vaylinkiselmukke" (hitch, see Figure 41 on page 63), leaving one turn around the bollard.

When the construction squad leader gives the command

SHOVE OFF

the number-3 men and number-4 men of the carrying squads shove off the off-shore ponton, with the construction squad of the shoreward ponton helping to keep it steady. During the shoving off, the mooring-line men pay out the mooring lines smoothly, loosening or tightening the lines as may be necessary so that the off-shore ponton will remain even with the shoreward ponton. The carrying squads' number-3 and number-4 men relinquish the balk to the construction squad in the shoreward; this construction squad then pins the balk to the shoreward gunwale of the shoreward ponton. The number-3 and number-4 men then leave.

After making certain that the balk are resting horizontally against the sides of the pontons, the construction squad leader commands

SECURE THE HANGERS,

at which command the construction squad in the shoreward ponton secures first the hangers on the off-shore side of the ponton and then the hangers on the shoreward side; in the off-shore ponton the construction squad secures first the hangers on the shoreward side and then the hangers on the off-shore side of the ponton. The hangers must not be made too tight. The mooring-line men in the off-shore ponton secure the mooring lines using a "vaylinkiselmukke" (hitch, see Figure 41 on page 63) and hang the coiled line on the bollard. The mooring-line man in the bow of the shoreward ponton takes a roller-beam, places it on the balk near the off-shore side of his ponton and also takes out a small boathook. After the hangers have been secured, the men who have secured them make an about face and are ready to receive the second length of balk (the center balk and the outer treadway balk).

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The carrying squads bring forth another length of balk and proceed as before.

At the command

BALK - FORWARD

the construction squad in the shoreward ponton receives the balk and places them on the roller-beam so that about 50 centimeters of the ends extend over.

At the command

HEAVE

the number-3 and the number-4 men of the carrying squad push the balk on the roller-beam, with the construction squad of the shoreward ponton helping to guide them, to the off-shore ponton, where the construction squad receives the balk and pins them.

When the construction squad leader gives the command

UP - RAISE

the construction squad in the shoreward ponton lifts the ends of the balk with the help of the carrying squad, the mooring-line man in the bow of the ponton quickly pulls the roller-beam toward him with a small boathook and the mooring-line man in the stern places the roller-beam in the ponton, after which, without commands, the balk are lowered to the gunwale and pinned. At the command SECURE THE HANGERS, the hangers are fastened in the same order as was followed in fastening the first length of balk. The carrying squad arranges itself in a double file behind the chess.

First, the construction detachment leader gives the command

LAY THE CHESS,

and then the carrying squad leader gives the command

CHESS TO SHOULDERS - RAISE.

The chess is taken from the pile in the manner described in Section 92.

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[Section 92 is herewith included]

[92. At the command CHESSE TO SHOULDERS - RAISE, the first pair of men go to the chess pile to hand the chess to the other pairs, taking their own chess last. Beginning with the third pair, the first man of each pair, in approaching the chess pile, must go under the chess that the preceding pair is carrying (Figure 66 on page 81).]

[The following is a continuation of Section 143.]

The first four pairs of men each bring, first, two chess for the ramp and set them in place (a pair of chess for each side of the outer treadway balk). The following pair brings an end chess and two chess and remains to lay the chess. The laying of the chess is carried out in the manner described in Section 96. For the delivery of the sidebeams, the last chess brought to the deck of the span are so spaced that the end chess is at a distance from the ends of the balk equal to its own width and the succeeding chess are spaced almost one chess-width apart.

When this is done, the carrying squads procure the 8-meter sidebeams and, with the men of the construction squads in the pontons helping to handle them, lay them directly into place. The construction squad fastens the sidebeams. After the sidebeams have been delivered and set into place, the laying of the deck is completed, with the mooring-line men in the pontons helping, by hand, to lay the chess and seeing to it that the end chess does not fall into the water. The extra chess in the equipage is used only for the ramp and it is placed on the bottom of the shoreward ponton beneath the deck of the span, after the ramp is no longer needed.

The carrying squads procure the anchor, the reel cases with their cables, the marker buoys and their mooring lines, the bunk beams and their clamps, the movement limiters, and the guard rail posts and guard

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rails. The bunk beams are placed flat on the off-shore end of the deck next to the siderails and the bunk clamps are placed in the bow and stern of the off-shore ponton. The washers on the movement limiters are all left on the limiters, which are fastened to the sidebeams. The attaching of the anchor lines to the anchor and the line of one marker buoy to the anchor is carried out on the deck of the span by the construction squad. The other marker buoy with its mooring line is placed beneath the deck in the shoreward ponton. The guard rail posts are placed beneath the deck in the bow and stern of the pontons and the guard rails are placed on the deck beside the siderails. The guard rails are not put up until the span is moved to the bridge or until it is begun to be used as a ferrying raft. Large boathooks and roller-beams can also be used as guard rails.

The construction squad leader will check to make sure that the lines are clear and that the equipage is correctly placed (See Figure 98 on page 134), so that it will be easy to shove the raft off.

II. Construction of the 6-meter and the 4-meter 4.5-ton Floating Span.

144. The width of the stream will determine whether a 6-meter or a 4-meter floating span should be used. For the construction of these spans, 2-meter sidebeams, balk and curb rails are needed from the abutment span truck and the "seka" span truck.

145. For the construction of the 6-meter floating span, the same equipage is required as that for the standard 4.5-ton floating span [8-meter] except that 2 4-meter sidebeams, 10 4-meter balk, and 2 4-meter curb rails are supplanted by the corresponding 2-meter members and also with the exception that only 10 siderail clamps are needed.

The transverse balk is not placed.

The strength of the construction detachment is the same as that

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required for the 4.5-ton [standard] span.

The construction is carried out in exactly the same manner as that for the standard 4.5-ton floating span.

146. For the construction of the 4-meter floating span, the equipage from two ponton trucks is required, as well as 4 2-meter sidebeams, which can be obtained either from two abutment span trucks or from two "seka" span trucks.

The construction of the span is the same as that of the standard 8-meter span except that the balk are not clamped; instead, 4-meter balk are used. The first length of balk is pinned to the off-shore side of the off-shore ponton and the last length of balk is pinned to the shoreward side of the shoreward ponton. A transverse balk is not placed.

The strength of the construction detachment is reduced to 1 - 2 - 20, since one carrying squad is omitted.

The construction of the span is carried out in the same manner as that of the standard 4.5-ton floating span. A roller-beam is not used.

III. Disassembly of the 4.5-ton Floating Spans.

147. Disassembly is carried out in the reverse order to that of assembly.

When the detachment leader gives the order to disassemble, the construction squad removes the guard rails and the siderail clamps and lays them on the deck. The carrying squads carry away the anchor-equipage, the bunk beams with their movement limiters and clamps, the guard rail equipage, the siderails, the curb rails, and the siderail clamps.

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The members of the construction squad in the off-shore ponton take the transverse balk and hang it near the gunwale on the shoreward side of the off-shore ponton and, together with the construction squad in the shoreward ponton, loosen the sidebeam hangers, with the carrying squads setting the ramp chess in place.

Each carrying squad, at the command of their leader, lifts a sidebeam from its place, with the construction squad helping to lift it by hand from the ponton, and carries it to the shore.

The chess is removed in the manner described in Section 97.

When the construction squad leader gives the command

LOOSEN THE CLAMPS,

the squad loosens the center balk and the outer treadway balk hangers, taking care that the balk do not fall flat.

At the command

UP - RAISE

the construction squad of the shoreward ponton, with the help of the carrying squad, lift the ends of the balk, taking care not to drop the balk, and the mooring-line man in the shoreward ponton shoves the roller-beam under the center of the lifted length of balk, using the small boathook to whatever extent may be necessary. When the roller-beam is in place, the balk are lowered to rest on it and the squad leader gives the command

BALK - REMOVE,

whereupon the carrying squads, with the help of the construction squad, slowly pull the balk to the shore and carry them away.

Once more the construction squad leader gives the command

LOOSEN THE CLAMPS,

whereupon the remaining hangers are loosened. For removing the balk, the construction squad leader gives the command

PULL IN

at which command the construction squad in the off-shore ponton bears down on the balk, and with the mooring-line men guiding the movement

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by the use of the mooring lines, the carrying squad pulls the off-shore ponton to the side of the shoreward ponton ponton by pulling on the balk.

The carrying squad carries the balk away.

The construction squad gathers the equipage from the pontons on the shore and according to the commands given, either organizes the equipage for loading or carries the material to be loaded elsewhere.

The carrying squads loosen the sidebeam and balk clamps, and either load the equipage into the trucks or arrange it for other purposes, as indicated by the commands given.

148. Disassembly of the 6-meter and the 4-meter 4.5-ton span is carried out in reverse order to that of the assembly and proceeds in the manner prescribed for the standard 4.5-ton floating span.

IV. Construction of the 8-meter 7-ton Floating Span.

149. The construction detachment, whose strength is 1 officer, 3 NCO's, and 32 men, is organized as follows:

—leader	1 officer or NCO
—construction squad	1 NCO and 16 men
—1. carrying squad	1 NCO and 8 men, and
—2. carrying squad	1 NCO and 8 men.

The preparations for the construction are carried out in the same manner as for the 4.5-ton span, except that in addition a third ponton is procured for placement between the other two pontons, and into this ponton is placed the necessary propulsion equipage, as well as 16 additional balk hangers. This middle ponton is secured to the shoreward ponton with mooring lines.

A transverse balk is not used.

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After fitting out the pontons with the necessary equipage, the construction squad arranges itself in the pontons as follows (See Figure 99 on page 138):

- in the shoreward ponton, 2 mooring-line men and 4 construction men,
- in the middle ponton, 4 construction men, of which the two end men serve as mooring-line men to whatever extent is necessary, and
- in the off-shore ponton, the squad leader, 2 mooring-line men and 4 construction men.

The construction is carried out in the same manner as that of the 4.5-ton floating span, except that during the shoving off, the construction squad in middle ponton, by holding on to the balk, move their ponton into the middle of the span, where it is fastened with the hangers.

The construction squad leader uses his squads to help the carrying squads to whatever extent is necessary.

The 20-millimeter washers that belong on the movement limiters are left on them but the 5 and 10 millimeter washers are placed in the bow and stern of the ponton.

150. The 7-ton floating span can also be constructed by converting a 4.5-ton span by removing the transverse balk from the 4.5-ton span and putting in its place a third (middle) ponton, into which 16 balk hangers in addition to the propulsion equipage, are placed.

The middle ponton is moved into place against the current, (or in still water, against the wind) loaded with 10 men, who push the ponton into position by pulling on the balk.

The squad leader directs the positioning of the middle ponton and gives the command for fastening the hangers.

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V. Construction of the 6-meter and the 4-meter 7-ton Floating Span.

151. The 6-meter 7-ton floating span differs in construction from the corresponding 4.5-ton span in that a transverse balk is placed in the middle of the span.

The construction is carried out in the same manner as described for the 4.5-ton floating span in Sections 144 and 145.

Figure 101 on page 140 illustrates the 6-meter 7-ton floating span.

The 4-meter 7-ton floating span is exactly the same by construction as the corresponding 4-meter 4.5-ton span (See Section 146).

VI. Disassembly of the 7-ton Floating Spans.

152. Disassembly is carried out in the reverse order to that of assembly.

VII. Construction of the 8-meter 12-ton Floating Span.

153. The construction detachment, whose strength is 1 officer, 3 NCO's, and 36 men, is organized as follows:

--leader	1 officer or NCO,
--construction squad	1 NCO and 20 men,
--1. carrying squad	1 NCO and 8 men, and
--2. carrying squad	1 NCO and 8 men.

For the construction, equipment is needed from four penton trucks, although the greater part of the equipment in these trucks will not be used.

154. The duties of the various squads in assembling the necessary equipment ^{are} ~~is~~ outlined in the following table:

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<u>Squad</u>	<u>Duties</u>
All squads	Place 4 pontons in the water.
Construction squad	Secure the end pontons to the shore with mooring lines and to the intermediate pontons, procure four equipment chests No. 9 and 4 pumps, and fit out the pontons. Into each ponton are placed 6 cars, 6 carlooks, a large boathook, a small boathook, 2 anchor cables, 2 mooring cables, 16 balk hangers and 1 pump; in addition to the foregoing equipemtn, the shoreward ponton and the off-shore ponton are both furnished with a reel, 8 sidebeam hangers, and in a swift current, a capstan together with its support arm and support bracket.
1. Carrying squad	Procure 10 4-meter balk, 4 4-meter sidebeams, 2 4-meter curb rails (of different color), 36 chess, 2 end chess, 2 bunk beams, an anchor, the reel case with its cable, the marker buoy with its line, 2 guard rail posts, a guard rail, a line stake, an engineer's sledge, and equipment chests No. 10 and No. 11. Take from the equipment chests brought to the construction site and from the baggage, 5 balk clamps, 2 sidebeam clamps, 6 siderail hangers, 4 bunk hangers, and 4 movement limiters. Fasten the balk and the sidebeams.
2. Carrying squad.	Same as those of the first carrying squad.

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The arrangement of the equipment and the positions of the members of the construction detachment are indicated in Figure 102 on page 142.

155. The construction is carried out in the same manner as that of the 4.5-ton span, with the following exceptions:

- during the shoving off, the construction squad, by holding on to the balk, move the third ponton into position beside the off-shore ponton and the second ponton into position beside the shoreward ponton. For pushing, the pontons are lashed together in pairs by the bbellards, using the mooring lines of the two intermediate pontons,
- in puttin the balk into place, a roller-beam is not used; instead, they are moved into place by hand,
- the deck is laid using a double layer of chess,
- double sidebeams are used, with the inner ones being laid first and the outer ones, and also the corresponding bunk equipage. The bunk beams are placed on the deck, and the movement limiters and the bunk clamps are placed in the end pontons.
- the 10 and 20 millimeter washers are left on the movement limiters but the 5 millimeter washers are placed in the bows and sterns of the pontons.

156. A 12-ton span can be constructe by converting either a 4.5-ton span or a 7-ton span, following the procedure set forth in Section 150.

VIII. Construction of 6-meter 12-ton Floating Span.

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157. The construction detachment, whose strength is 1 officer, 3 NCO's, and 32 men, is organized as follows:

--leader	1 officer or NCO
--construction squad	1 NCO and 16 men
--1. carrying squad	1 NCO and 8 men, and
--2. carrying squad	1 NCO and 8 men.

For the construction equipment is needed from three ponton trucks and two abutment span trucks, although the greater part of the equipment in these trucks will not be used.

The construction is carried out in the same manner as for the standard 7-ton floating span except that a roller-beam is not used, and the carrying squads procure double sidebeams, double bunk equipage, and double chess.

Figure 104 on page 144 illustrates the completed 6-meter 12-ton floating span.

[The duties of the various squads in assembling the equipment are given in the following table:]

<u>Squad</u>	<u>Duties</u>
All squads	Put 3 pontons in the water.
Construction squad 4	Secure the pontons to the shore with mooring cables, procure 2 equipment chests No. 9 and 3 pumps, and fit out the pontons. Into each ponton are placed 6 oars, 6 oarlocks, a large boathook, a small boathook, 2 anchor cables, 2 mooring cables, 16 balk hangers, and 1 pump; in addition to the foregoing, the following equipment is placed in both the off-shore ponton and in the shoreward ponton: a reel, 8 sidebeam hangers (6 from the equipage brought to the construction site

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and

and 2 additional ones from the baggage) and for a swift current, a capstan, with its support arm and support bracket.

1. Carrying
squad

Procure 5 4-meter and 5 2-meter balk, 2 4-meter and 2 2-meter sidebeams, a 4-meter curb rail and a 2-meter curb rail (of different color), 26 chess, 2 end chess, 2 bunk beams, an anchor, the reel case with its cable, the marker buoy with its line, 2 guard rail posts, a guard rail, a line stake, an engineer soldier's sledge, and equipment chests No. 10 and No. 11. Take from the equipment chests brought to the construction site and from the baggage, 5 balk clamps, 2 sidebeam clamps, 5 siderail hangers, 4 bunk hangers, and 4 movement limiters. Fasten the balk and the sidebeam.

2. Carrying
squad

Same as those of the first carrying squad.

IX. Construction of the 4-meter 12-ton Floating Span.

158. The strength of the construction detachment is the same as that required in constructing the corresponding 4.5-ton span.

By construction the 12-ton 4-meter floating span differs from the corresponding 4.5-ton span in that the 12-ton span is assembled using double sidebeams, double bunk equipage, and double chess.

Figure 105 on page 146 illustrates the 12-ton 4-meter floating span.

X. Disassembly of the 12-ton Floating Spans

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159. Disassembly is carried out in the reverse order to that of assembly.

G. Construction of the Hinge Span.

175. The floating span that supports the hinge span is either made as such originally or by adding an intermediate ponton to a standard floating span, in the manner indicated by Figures 121a, 122, and 123, on pages 160 and 161. One end of the hinge span rests either on an abutment sill or on a trestle transom, and in the latter case two additional balk seats are placed on the transom between the side balk and the outer treadway balk (Figure 119 on page 158).

The height of the abutment sill or the trestle transom above the level of the water is 145 centimeters.

The construction detachment for the assembly of the deck section of the hinge span has a strength of 1 officer, 3 NCO's, and 20 men, and is organized as follows:

--leader	1 officer or NCO
--construction squad	1 NCO and 4 men
--1. carrying squad	1 NCO and 8 men, and
--2. carrying squad	1 NCO and 8 men.

For the assembly, the necessary equipage is arranged as indicated in Figure 120 on page 159.

The duties involved in procuring the equipage are distributed among the squads as follows:

<u>Squad</u>	<u>Duties</u>
Construction squad	Procure the floating sill and deck ramp, and 2 anchors with their cables.
Carrying squads	Procure 8 hinge span balk and 10 deck panels.

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176. In constructing the hinge span from the trestle transom, the construction squad lifts the abutment span's trestle transom, using the hoist, so that the upper edge of the transom is 145 centimeters above the surface of the water, and places the floating sill on the floating span near the shoreward gunwale of the off-shore ponton. The floating span is secured so that the shoreward gunwale of the shoreward ponton is at least 20 centimeters from the trestle transom. If the bridge is to have two hinge spans, shore anchors must be used.

At a signal from the construction detachment commander, the leader of the first carrying squad takes charge of both carrying squads and directs them in bringing the treadway balk into place, with the construction squad assisting from the span. The balk are placed to rest on the floating sill and in the balk seats on the trestle transom, (See Figure 119 on page 158), the first length of balk is secured, and the carrying squads procure the second length of balk and put it in place. After this is completed, the carrying squads procure the deck ramp, which the decking men of the construction squad put into place. When the decking has been completed, the construction squad puts the deck ramp into place.

Figures 121a, 121b, 122, 123, and 124, on pages 160 and 161, illustrate the 4.5-ton, the 7-ton, and the 12-ton hinge spans.

177. For "adjusting" the hinge span, [i.e. for changing the distance between the floating support of the hinge span and the trestle transom or abutment sill], the decking of the hinge span is removed as well as the second length of balk (the sidebalk and the center balk), and these are placed on the next floating span or on the abutment span.

The carrying squads take places near the balk, as indicated in Figure 125 on page 162, with the construction squad men acting as moor-

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ing-line men.

At the command

UP - RAISE, PUSH

the carrying squads raise the balk and the floating sill, and push the span outwards with their feet. On the 4.5-ton and the 7-ton bridges, it is possible to move the floating sill near the off-shore side of the shoreward ponton (See Figures A21b and 122 on pages 160 and 161), wherein the adjustable gap is 465 centimeters; on the 12-ton bridge the floating sill can be moved to the more shoreward of the two middle pontons (Figure 124 on page 161), wherein the adjustable gap is 385 centimeters.

Closing the adjustable gap is carried out by the same procedure, except that the construction squad which is acting as mooring-line men pull the span toward the shore using the mooring lines that have been tossed to them from the shore.

After the gap has been adjusted, the construction squads bring the second length of balk and the decking into place and put the deck ramp into place.

Disassembly of the hinge spans is carried out in the reverse order to that of assembly.

H. Construction of Bridge Spans at the Bridge Head.

178. Construction of a bridge at the bridge head is considered only in the exceptional cases where a poor and scanty road network and very steep banks on the shore prevent the assembly of the bridge on a large scale.

Where there is the slightest possibility that the bridge can be assembled in several places, this possibility must be exploited because of the considerable amount of time that this procedure gains.

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The assembly must be fully prepared for by carrying out a careful, detailed reconnoitering and organization of traffic. The grouping together of vehicles and equipment must be avoided, and there must be no interruptions in the delivery of the equipment.

179. If it is possible to put the pontons in the water only at the bridge line, the pontons and the necessary outboard motors are lowered into the water before the abutment span is assembled. The pontons are fastened together in pairs and moved to a spot from which, depending on the strength of the current and on the nature of the shoreline, it is most advantageous to move to the bridge line, and at which anchoring to the shore can best be carried out. If possible, the pontons are lowered into the water elsewhere and the bridge line is then open for assembly of the span.

180. Depending on how well the terrain at the bridge line is suited for assembling the spans, either the floating span is assembled first and the abutment span equipped for the opposite shore is loaded on it, or the abutment span is assembled, from which the floating spans are assembled by hand.

181. To make the greatest possible speed in completing the construction of the bridge, it is best to assemble the bridge just as fast as the construction of the spans starting from the opposite shore is carried out and to construct last the abutment span and the hinge span for the near shore. The construction of the balk lengths by hand from the near shore is to be avoided, since the long carrying distances would both slow up the operation and overexert the carrying squads, whose numbers would have to be increased.

The floating spans are constructed in the normal fashion, using

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shore-anchors for anchoring them. In order to prevent accidents, the pontons of the last three spans to come to the bridge, drop their anchors and drift downstream to the limit of their anchors, and then in turn pull themselves up the construction site with lines.

The men who bring the spans up to the bridge are then brought to the near shore by assault boat, downstream of the bridge, with the mooring-line men remaining on the span.

182. If the bridge must be built a balk length at a time, by hand from the near shore, 2-4 times the number of carrying squad men must be used (depending on the length of the bridge). In order to prevent accidents, the pontons of two spans anchored to the shore at the bridge head must be kept the regulation distance apart, secured together by spans by the bollards.

Construction of the/^{floating} spans by hand from the bridge is carried out in the same manner as from the shore by hand. For the time of construction, the shoreward ponton is tied to the off-shore ponton of the last floating span, with mooring cables. The shoving off of the off-shore ponton is regulated by the mooring-line men, using a mooring line that runs around the bollards of the shoreward ponton.

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CHAPTER 9 SPECIAL PROCEDURES IN BRIDGE BUILDING

B. Channel Passages, their Opening and Closing.

267. To whatever extent is necessary, a drawspan is arranged in a ponton bridge at the point where a channel passage is necessary for boats or for floating timber. In the single-type channel opening, there is only one drawspan with two base spans; the double channel opening there are two drawspans, with two or more base spans. In order to allow larger craft, such as bridge spans and bigger ships to pass, as well as to provide for operations on the water during darkness, it may be necessary to remove several spans from the bridge. Immediately after the bridge has been completed, the drawspan must be marked with a sign, (for example, a small board), with chalk, and with semaphore flags, to indicate to boats at what time the channel passage is open or closed, in accordance with Section 328. Otherwise, the pertinent maritime regulations are followed.

268. For the upstream anchors for the channel passage base spans, either a single or double anchor is used, or a chain anchor; the anchor lines are double length. The downstream anchors are arranged in the manner generally used for ponton bridges (See Figure 155 on page 233). In shallow water, anchors must not be dropped in the boat channel. The downstream anchors must not be dropped too near the bridge, and they must be fitted, insofar as is necessary, with double anchor lines. In opening the channel passage, it may become necessary to hoist the downstream anchors.

The opening of the drawspan is carried out in the same manner as a forced disassembly, without, however, leaving the anchor lines and in narrow channel passages without lifting the upstream anchors (Figure 156 on page 234).

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In wide channel passages, the center spans hoist their anchors.

269. The channel passage is opened at the order of the bridge officer on duty.

At the command

PREPARE TO OPEN THE DRAWSPAN

the drawspan (s) is secured for the operation from both ends by the bollards, using the figure eight hitch (See Figure 49a and b on page 67), the corresponding bunk beams are removed and the floating span of the nearest hinge span is pulled about 1 meter toward the shore. The guard rails on the drawspan are removed. The end spans, which remain in place at the bridge head, are secured to the neighboring spans using the figure eight hitch mentioned above, and the bunk beams are removed.

At the command

OPEN THE DRAWSPAN

the drawspans are allowed to go downstream with the current, being held in check by the downstream anchors, with the downstream anchor lines meanwhile being reeled in to the spans. On arriving at the downstream side of the bridge, the drawspans are brought into a tacking position, when the men in charge of the spans so command, tack toward the shore to a position on the downstream side of the section of the bridge that has remained in place, and situate themselves in such a way that the off-shore ponton of the drawspan comes to rest near, or on the shoreward side of, the off-shore ponton of the the bridge span that has remained in place. It may prove advantageous to pay out a little more of the downstream anchor cables on that section of the bridge that has remained in place. Under no circumstances must the spans in the draw-

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span, or their anchors, be allowed to hinder traffic through the channel passage. At the bridge heads on both sides of the channel passage, the bunk beams are removed from two or three spans and figure eight hitches ("kahdeksikot," see Figure 49 on page 67) are used in their places; the anchor lines are manned and so arranged that they can be paid out immediately when needed.

To help in the maneuvering of the drawspans, two tug-lines are attached from each of the drawspans to the bridge so that the men stationed on the bridge can pull the drawspans by hand into the positions designated by their leaders. (See Figure 156 on page 234). (For these tug-lines, either double length mooring cables or anchor cables are used; the tug-line on the off-shore side is called the off-shore cable and the tug-line on the shoreward side is called the shore-cable).

In swift current, the tug-lines cannot be used in the maneuvering; instead, only the anchor lines can be used. The tug-lines are used in swift current only for pulling the drawspans into place against the current, with the tug-lines being passed to the drawspan from the bridge.

The drawspans are secured to the bridge with mooring lines by securing to the bollards on the nearby pontons. In swift current, this securing is not done, lest too much stress be put on the upstream anchors.

270. The closing of the drawspan is carried out when the bridge officer on duty gives the command

CLOSE THE DRAWSPAN,

at which command, the drawspans are detached from the bridge, according to the orders of the leaders on the drawspans, allowed to drift a little downstream, and then moved out to positions opposite their respective places in the bridge; then they are moved up to the

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bridge line. When the floating span of the hinge span has been moved off-shore again into its position, coupling of the units is again carried out with the bunk beams.

271. The movement of the drawspans is facilitated by the use of outboard motors, either in the pontons or in assault boats.

C. Bridge Construction and Movement on the Ice.

I. Construction on a Frozen Stream.

272. If the ice on a frozen stream is not strong enough to support the necessary traffic, it is necessary in urgent cases to build a bridge with ponton equipage. The construction of a bridge over a frozen stream requires special caution and special procedures to protect the bridge from damage, which may easily result from the bridge being frozen in, or from the breaking up of the ice.

273. Whenever the depth of water permits, it is always advantageous to build a trestle span.

If the ice is strong enough to support alone the squads involved in setting up the trestles, then the recommended procedure is to set up the trestle columns through holes that have been hacked into the ice. These holes are prepared by the construction squad (See Section 121). If the ice is weak, then boards or planks must be laid on it for working on, or if the conditions permit, the ice can be strengthened by freezing.

The lower ends of the trestle's longitudinal lashings are attached above the ice, or slitwise openings are made in the ice for them.

If the ice is so weak that the abovementioned procedure cannot be followed, then the trestle span must be constructed by making a continuous, wide opening in the ice, starting from the shore, into which

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opening the trestles are set, either from the shore by hand (See Sections 121-129), or from a hinge span raft (See Sections 130-138).

274. If the depth of water or the type of bottom does not permit the construction of a trestle span, then the bridge must be constructed using pontons. The construction is carried out a balk length at a time.

If the ice is strong enough to support activity, the pontons are set in the bridge by first making a hole in the ice for the ponton and then pulling the ponton over the ice into its position.

If the ice is too weak, the following procedure must be followed. From the shore a sufficiently large hole is made in the ice; the bridge is then best made by putting one ponton into the water at a time from the shore and pushing the bridge out in the opening as the bridge is assembled, one balk length at a time. The pontons are not anchored in the usual manner, but instead a steel cable is stretched out as a main anchor line from the upstream side, and if necessary, from the downstream side, and the anchor cables are attached to it.

The openings in the ice for the pontons and the trestle columns must be kept open continuously; also, ice must be carefully removed from between neighboring pontons.

In other respects, the construction of the bridge is carried out in the usual manner.

II. Construction and Travel in Ice that is Breaking up.

275. Bridge construction in ice that is breaking up is particularly difficult. Difficulties appear so often and are of so many different kinds that it is impossible to predict exactly how much time the passage of equipment or the construction of the bridge should take.

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Construction of a bridge in ice that is breaking up is feasible only if the ice floes floating down the stream with the current are small (1-2 square meters) and infrequent enough so that it is possible to direct the ice past the bridge while it is under construction and after it is completed. If the ice floes are larger, then construction of a bridge is possible only if the ice floes can be successfully broken up at some point far enough upstream from the bridge. Construction of a bridge at night, when the ice is breaking up, is not possible; neither is it possible to open or close the drawspan when the ice is breaking up.

276. It is best to anchor the bridge using a main anchor cable. The trestles must be fitted on the upstream side with a strong set of slanting supports that will lead the ice floes away from the trestles. The longitudinal lashings of the trestles must be fastened at their lower ends to points on the trestle columns high enough above the level of the water so that ice floes cannot reach them. In swift current or where there is quite a bit of broken-up ice, the weak sides of the pontons must be protected by attaching to them either poles or boards fashioned into a grating-like protecting shield. In general, the bridge is assembled a balk length at a time, and the pontons are brought to the bridge downstream one at a time. The protective measures to be taken for the completed bridge are presented in Chapter 11. If the bridge is to be used for a rather long period of time, then its protection from ice floes can be effected by building an ice-breaker afterwards, by ramming it into the ground.

277. Regular passage across a stream during a strong flow of ice is not possible. If individual pontons are to make a passage across a stream during a weak flow of ice, special procedures must be invoked. The sides of the pontons must be protected from ice floes

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with protectors, which are made of boards or poles. It is advantageous to fit out the pontons with outboard motors. For rowing, 2-4 rowing men must be added to the usual number. According to the circumstances, it may at times be advantageous to row and pole at the same time. Ice floes are directed past the ponton with a small boathook. Large ice floes must be avoided. The pontons must be fitted out with towing lines, for towing from shore which are extended lashings attached to mooring cables. Since travel upstream, even by towing from shore, would be difficult, it is worthwhile to arrange the loading places stepwise downstream. So that the poling men will be able to steer clear of floating ice floes, there must be enough room in the ponton for them to move about. For this reason, the load that the ponton is transporting must be limited to one half or one quarter of the normal load.

278. If there is locked-in ice or pack ice on the shores, each ponton must be fitted out with two ice chisels (or lacking these, 2 engineer's sledges) for breaking a channel through the ice. To whatever extent is necessary, special squads can be assigned to both shores for breaking open a channel for loading and unloading places. Often it is advantageous to use a board walkway that can be quickly laid down, or alternatively, a floating foot-bridge.

279. In dangerous circumstances, as for instance when engineers are working upon the ice, safety lines must be fastened to the men. In ice that is breaking up, each craft that is moving about must have its own rescue equipment, since special rescue craft could not reach the scene of an accident in time.

280. If it is necessary to use rafts for transporting, say horses or vehicles, it is usually necessary to use an outboard motor

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on the pontons of a raft; the use of assault boats for this purpose is not feasible.

D. Deflecting Barriers.

281. Objects floating down the stream with the current may easily damage a ponton bridge (these include such things as individual logs, as well as timber rafts loaded with bricks or firewood, and floating mines). For this reason, and particularly if the bridge is to remain in place for a long time, a deflecting barrier should be built. The deflecting barrier is set at an angle of about 30° to the direction of the stream, and acts to decrease the force of impact on the bridge of floating objects; often, also, it serves to veer the objects toward the shore, or at least makes it easier to do so. Another purpose of the barrier is to cause contact mines to explode.

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CHAPTER 12 --Use of Ponton Bridge Equipage in Over-water Transport and Movement of the Equipage over Water.

A. General Information.

348. When ponton bridge equipment is to be transported for a great distance over water, the channel to be travelled must be investigated beforehand. Although, very often, local officials can furnish sufficiently accurate information on the nature of the watercourse and on the channel, under unfavorable circumstances and especially where shallow water prevails, the channel for the entire route must be known before the actual movement begins. Often it is advantageous to use the local pilots, masters, and mates, who are well acquainted with the channel. The widths of the passages through canal locks and bridge drawspans must be learned beforehand.

If in swift current the movement is conducted with special base spans, they must follow each other at a minimum distance of 100 meters. Where there are narrow canal locks and drawspan passages, it may be necessary to use 6-meter and 4-meter spans in place of the standard spans. In travelling downstream in a watercourse, in which there are frequent changes in the depth of water and the direction of the channel, the channel experts should travel ahead of the movement in either an assault boat or a ponton fitted with an outboard motor, and mark the channel indicating the shoals and reefs; to do this they use marker stakes that are fitted, as needed, with bundles of brush or trees that have been pruned almost to the top. When it is necessary to go under bridges, the channel passage must be marked also; during peacetime, the regular drawspan passage must be used.

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B. Construction of Spans and Towing of Spans.

349. The columns of ponton bridge equipage arranged for towing are composed of standard 4.5-ton spans and corresponding rafts for transporting the different sizes and weights of loads over water.

When the passage in canals and the drawspan openings in bridges are so narrow that 8-meter spans cannot fit through them without being damaged, the spans must be built as 6-meter or 4-meter spans. The 6-meter spans are constructed either by using 4-meter and 2-meter balk and sidebeams or by placing 4-meter balk and sidebeams so that their ends overlap on the gunwale of the middle ponton and there is a transverse balk on both sides of this gunwale; 4-meter spans are constructed either by using 2-meter balk and 2-meter sidebeams or by placing, for example, 4-meter balk (16 pieces) and 4-meter sidebeams (4 pieces) so that their ends overlap, with a transverse balk over the middle of each ponton.

The number of spans in the column being towed depends on the strength of the current and on the narrowest places in the channel (canals and bridge drawspans).

In travelling downstream, it may be necessary in passing through a narrow place, to attach the towing boat to the stern of the last span in the column and have the motor of the towing boat running backwards. In this case the span at the head of the column will have to be steered by using the set of oars farthest astern.

For travel through particularly close places in swift current, the column of spans must be broken up into the individual spans, which pass through the narrow place under the restraining influence of an anchor cable.

For towing, the first span is attached to the towing boat with two anchor cables, which are secured on the span to the inside bow

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bollards of the ponton; the spans are secured to each other with mooring cables from the bollards on both sides of the spans and so arranged that the distance between the stern of a span's ponton and the bow of the following ponton is 0.5 - 1 meter. Both the anchor cables and the mooring cables are attached using figure eight hitches (See Figure 49 on page 67) and used in the manner described in Section 79. The manner in which the anchor cables are attached to the towing boat depends on the equipment on the towing craft and if there are no towing hooks on the craft, the towing lines must be attached crosswise. When there is reason to suspect that the mooring lines may not be strong enough (the lines may be old or worn), anchor cables may be used in their place, with the anchor cable going through all of the spans but attached only to the outside bollards and secured to them with a "vaylinkisolmukke" (hitch, see Figure 41 on page 63), beginning with the bow bollard of the first span; the lines are secured in the manner described in Section 79.

For the movement, men must be assigned to the bow and stern of each ponton, for poling.

To improve the steering, the spans can be fitted out with outboard motors, in which case the distances between consecutive spans must be adjusted accordingly. Also, in either weak or swift current, it is possible to attach assault boats alongside the outer side of several spans to help in steering the column around bends.

Each towing column must have attached to it either assault boats or flat-bottomed rowboats, for casting the anchors.

If it is necessary to use local civilian craft for towing, it is necessary to carry out the special procedure pertinent to the special equipment, and practices used on the craft regarding the current and other conditions.

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A commander must be named for the transport column, and for each span, insofar as it is possible, there should be a full complement of men (See Section 112). The distance between columns is dependent on the swiftness of the current; however, it should be at least 500 meters.

During towing against a strong current, the following special procedures must also be followed:

--equipment should be furnished for plugging leaks and for bailing water;

--in order to make the bow lighter, the men and the load should be situated more toward the stern of the span, and the bow section of the pontons should be covered either with a canvas or with a decking of boards;

--the distance between the towing craft and the first span should be at least 50-100 meters, and no load is to be placed on the first span.

C. Towing Craft.

350. For towing great distances against a strong current, actual towing craft must be used.

The use of outboard motors for towing must be limited to short distances, chiefly in weak current, or with the current.

351. Before the movement begins, the men in charge of the spans and the columns, as well as the men who are to operate the outboard motors, must familiarize themselves with the regulations currently in force with respect to water traffic and with any other special, pertinent regulations.

An agreement must be reached with the commander of the towing craft as to the signals to be used for starting, stopping, or for travelling faster or more slowly.

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